



## CERTIFICATE

I, Thomas Kitzhofer, of Manzingerweg 7, 81241 München, Germany, declare that I am conversant with the German and English languages, and that to the best of my knowledge and belief the accompanying text is a true translation of the priority document issued by the German Patent and Trademark Office on 15 July 2003, for Serial No. 102 40 639.1.

Signed this 9th day of January 2006

A handwritten signature, appearing to be "Kitz", written in black ink above a horizontal line.



Certified Translation

**FEDERAL REPUBLIC OF GERMANY**

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**Certificate of Priority Relating to the Filing  
of a Patent Application**

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**Applicant/Owner:** TRW Airbag Systems GmbH & Co KG,  
Aschau am Inn/Germany

**Title:** Gas Generator

**IPC:** B 60 R 21/26

**The attached documents are a correct and true copy of the original documents  
of this patent application.**

[seal of the  
German Patent  
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Munich, dated 15 July 2003  
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**The President**  
By:

(signature)

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## Gas Generator

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The invention relates to a gas generator comprising an elongated, preferably tubular outer housing, at least one combustion chamber provided therein which is filled with a propellant bed and a solid propellant, and at least one igniter unit for  
5 igniting the solid propellant.

Elongated gas generators, also known as tubular gas generators, usually have an axial length which distinctly exceeds the diameter of the outer housing. The length generally amounts to more than twice the diameter. The gas generators are to make possible a rapid ignition of the propellant across a large area. A possible  
10 problem in the through-flow of the solid propellant through already generated gas is the erosion on the surface of the propellant, which can lead to an output development which is more difficult to calculate. The aim is therefore to achieve a "gentle" ignition of the propellant and to avoid an intense erosion of the propellant, whereby high pressure peaks in the combustion chamber can be  
15 avoided and at the same time the minimum pressure in the combustion chamber, necessary for combustion, can be maintained at a certain level over the entire duration of combustion. Furthermore, it is to be achieved that the combustion chamber can easily be filled with solid propellant.

The above-mentioned advantages are achieved in a generic gas generator in  
20 that the igniter unit is arranged laterally externally on the outer housing and that a

preferably radial ignition transfer opening, in relation to the outer housing, is provided for the introduction of the ignition gas, generated in the igniter unit, into the interior of the outer housing. In the gas generator according to the invention, the igniter unit does not project axially into the combustion chamber, but rather  
5 the igniter unit is arranged outside the outer housing, so that the so-called ignition gas can arrive out of the igniter unit via the radial ignition transfer opening into the interior of the outer housing and hence into the combustion chamber. Through this so-called lateral ignition, on the one hand a greater ignition surface can be made available, and on the other hand the igniter unit no longer projects deep into  
10 the combustion chamber, which facilitates the filling process of the combustion chamber with solid propellant and leads to a better fixing in position with the use of propellant tablets. In addition, radial outflow openings are provided in the outer housing, so that the propellant bed is not flowed through in axial direction, as in the prior art, and hence in its greatest extent, but rather is flowed through radially  
15 on a shorter path, which reduces the erosion of the propellant.

The igniter unit, in accordance with an embodiment, does not project into the combustion chamber, so that the igniter unit in no way impedes the filling of the combustion chamber.

The filling opening for the preferably cylindrical combustion chamber is  
20 arranged in axial direction.

The combustion chamber is to be constructed as far as possible without an undercut; it should be e.g. cylindrical as already mentioned, in order to make possible a complete and simple filling. With a cylindrical construction of the combustion chamber, the longitudinal axis of the combustion chamber is to run  
25 parallel to the central axis of the outer housing, in order to achieve a compact construction.

The so-called ignition gases, i.e. the mixture of particles and gas which is produced by the igniter unit, can arrive into the combustion chamber even better distributed when a distribution space for the produced ignition gas is provided

between the inner face of the outer housing and the combustion chamber wall. The ignition transfer opening also opens out into the distribution space. The distribution space preferably extends across the entire axial length of the combustion chamber, so that the gas spreads out from the igniter unit along the  
5 preferably elongated distribution space on the entire axial length and from there arrives across a very large area into the combustion chamber, which leads to a so-called "gentle" ignition of the solid propellant.

According to the preferred embodiment, an expansion space for gas is arranged between the combustion chamber and outflow openings on the outer  
10 housing, which can likewise extend across the entire axial length of the combustion chamber.

The distribution or expansion spaces can be formed in that the combustion chamber wall, constructed as an insert, has at least one radially inwardly directed indentation, which as stated preferably runs across the entire length of the  
15 combustion chamber.

Except for the distribution and expansion spaces, the insert can lie with its entire surface against the inner face of the outer housing and can therefore be positioned so as to be securely in place.

The insert can be constructed as a single-layered filter or as a perforated sheet,  
20 which makes it possible to dispense with a thick filter insert in the entire gas generator.

A preferred embodiment makes provision that the outflow openings are arranged in a region lying diametrically opposite the ignition transfer opening, i.e. on one side the introduction of the ignition gases takes place, which are firstly  
25 distributed axially, in order to then penetrate the propellant bed, and it is only on the opposite side that the generated gas can first flow out from the gas generator.

Further features and advantages of the invention will be apparent from the following description and from the following drawings, to which reference is made. In the drawings:

5     - Figure 1 shows a longitudinal sectional view through a first embodiment of the gas generator according to the invention,

      - Figure 2 shows a cross-sectional view along the line II-II in Figure 1,

      - Figure 3 shows a longitudinal sectional view through a gas generator according to the invention in accordance with a second embodiment along the line III-III in Figure 4,

10     - Figure 4 shows a cross-sectional view through the gas generator along the line IV-IV in Figure 3,

      - Figure 5 shows a longitudinal sectional view through the gas generator according to the invention in accordance with a third embodiment,

15     - Figure 6 shows a cross-sectional view through the gas generator along the line VI-VI in Figure 5, and

      - Figure 7 shows a cross-sectional view through the gas generator according to the invention in accordance with a further embodiment.

      In Figure 1 an elongated tubular gas generator is illustrated, which has a cylindrical outer housing 10. The tubular gas generator consists of two stages 12, 14, which can be activated independently of each other and have associated igniter units 16, 18. The outer housing 10 of the gas generator is composed of two cylindrical tubes 20, 22 closed on one side, which are connected with each other by an intermediate wall 24. Inside the outer housing 10, each stage is provided with its own cylindrical and elongated combustion chamber 26, 28, which is filled with solid propellant 30 in tablet form to form a propellant bed. The combustion chambers 26, 28 are formed by a combustion chamber wall 32 in the form of a cylindrical filter body insert, open on both sides and closed peripherally. This

filter body lies on the inner face of the outer housing 12 across its entire surface, but has two radially inwardly directed indentations extending across its entire axial length, which lie in regions diametrically opposite the central axis A of the outer housing 10. These indentations, together with the inner face of the outer housing 10, delimit spaces extending across the entire axial length of each combustion chamber 26, 28, namely a distribution space 40 and an expansion space 42, which is arranged in the region of outflow openings 44 in the outer housing 10. Diametrically opposite the outflow opening 44, there is provided for each igniter unit 16, 18 in the outer housing 10 an ignition transfer opening 50. This is aligned radially to the central axis A.

Each igniter unit 16, 18 consists of a cup-shaped housing 52, which is placed laterally from the exterior onto the outer housing 10. In the housing 52, an igniter 54 and a booster charge 56 are arranged. An ignition transfer opening 58 on the end face, running radially to the central axis A, allows the outflow of so-called ignition gases, i.e. the combustion products (gas and particles) on activation of the igniter 54 and combustion of the booster charge 56.

In the region of the ignition transfer opening 58, adjacent to the combustion chamber wall 32, an axially short, curved baffle plate 60 is arranged, which does not have any openings.

With regard to the igniter units 16, 18, it is to be emphasized that these can only lie against the outer face of the outer housing 10 or, as illustrated in Figure 1, also partially project into the ignition transfer opening 50.

In each case, however, the igniter units 16, 18 do not project into the combustion chambers 26, 28.

For filling the combustion chamber, the two tubes 20, 22 are not yet connected with each other, so that they each have an axial filling opening (open end). As the combustion chambers 26, 28 are constructed without undercuts, they can be filled completely and very simply axially with solid propellant 30. Then in each case an

elastic filling disc 70 is introduced, before both tubes 20, 22 are fastened to the intermediate wall 24.

The mode of operation of the illustrated gas generator is explained below. When one of the igniters 54 is activated, a combustion of the booster charge 56 is brought about, and hot ignition gas escapes from the housing 52 via the ignition transfer opening 58 and flows radially into the outer housing 10. The ignition transfer opening 50 permits the inlet of the outflow gases into the interior of the outer housing 10. The gas strikes directly onto the baffle plate 60 and is deflected axially through 90 degrees, therefore distributes itself on the entire length in the distribution space 40 and finally arrives into the corresponding combustion chamber 26, 28. The solid propellant 30 is ignited across a large area and the resulting gases can leave the combustion chamber across a large area in the direction of the expansion space 42 and finally leave the outer housing 10 via the outflow openings 44.

High peak pressures in the combustion chambers 26, 28 are avoided; a gentle ignition of the propellant takes place, the necessary minimum pressure being able to be kept at a certain level over the entire duration of combustion.

The embodiment according to Figures 3 and 4 corresponds in part to that according to Figures 1 and 2, so that the reference numbers already introduced are used for parts having identical function and only the differences which exist need to be described in detail.

The solid propellant 30' is constructed in disc form with a central opening. The discs, which are asymmetrical to the central axis, are stacked one on another and may have small extensions or protuberances on the end face for reciprocal spacing. Each combustion chamber 26, 28 has two stacks of solid propellant discs 30', which in the region of the opening 58 for the central entry of gas are spaced apart from each other for example by means of two sheet metal discs 72. The sheet metal discs 72 have openings in the region of the holes 70. It could therefore be stated that in the embodiment according to Figure 3, each combustion chamber



26, 28 is divided into two smaller combustion chambers 126', 126'' and 128' and 128''.

For each stack of solid propellant discs 30', in addition its own cylindrical filter body is provided, which forms the combustion chamber wall 32.

5 As can be seen from Figure 4, there are two peripherally spaced rows of outflow openings 44 in the outer housing 10. The combustion chamber wall 32 has two indentations which each are associated with a row of outflow openings 44, so that two expansion spaces 42, seen in cross-section, are produced. The expansion spaces 42 extend across the entire length of each pack of solid  
10 propellant tablets 30' and therefore across an associated, divided, separate combustion chamber 126', 126'', 128', 128''.

In this embodiment, the gas generated in the igniter unit 16, 18 flows via the ignition transfer opening 58 out from the corresponding igniter unit 16, 18 and radially into the outer housing 10. The ignition transfer opening 50 permits the  
15 entry of the ignition gas into the interior of the outer housing 10. The gas arrives into an intermediate space 80 and into a central channel 82 which is formed by the openings 70 in the solid propellant discs 30', so that the solid propellant 30' is ignited radially from the inside. The generated hot gas arrives into the expansion chambers 42, from where it leaves the outer housing 10 via the outflow openings  
20 44.

The embodiment according to Figures 5 and 6 corresponds substantially to that shown in Figure 1 and 2. Here, however, the baffle plate 60 is omitted. Instead of this, a nozzle-shaped extension 90 additionally projects out from the housing 52 into the distribution space 40. The nozzle-shaped extension 90 has a  
25 radial ignition transfer opening 58, which is constructed as a blind bore. This blind bore meets a through-bore 92 running perpendicularly hereto, which is aligned parallel to the axis A.

The gas generated in the ignition unit 16, 18 is deflected through 90 degrees in the nozzle-shaped extension 90 and leaves the latter in two streams which run

parallel to the axis A in the direction of the distribution space 40, from where it ignites the solid propellant 30 across a large area. The generated gas finally arrives into the expansion space and leaves the outer housing 10 via the outflow openings 44.

- 5        In the embodiments shown, the ignition transfer openings 58 in the housing 52 direct the ignition gas into the outer housing 10. If, however, the housing 52 does not partially project through the ignition transfer opening 50, the ignition transfer opening 50 also directs ignition gas into the interior of the outer housing 10.

- 10        The embodiment according to Figure 7 corresponds substantially to that shown in Figure 4, the filter defining the combustion chamber wall 32 being omitted. To provide a distribution space 40 and an expansion space 42, the solid propellant discs 30" have flattened areas or indentations 100.

Claims

1. A gas generator comprising an elongated, preferably tubular outer housing (10),

at least one combustion chamber (26, 28) provided therein, which is filled with  
5 a solid propellant (30; 30'), and

at least one igniter unit (16, 18) for igniting the solid propellant (30; 30'),

characterized in that the igniter unit (16, 18) is arranged laterally externally on  
the outer housing (10) and that a preferably radial ignition transfer opening (50,  
58), in relation to the outer housing (10), is provided for the introduction of the  
10 ignition gas, generated in the igniter unit (16, 18), into the interior of the outer  
housing (10).

2. The gas generator according to Claim 1, characterized in that the ignition  
transfer opening (50, 58) is provided in the igniter unit (16) and/or in the outer  
housing (10).

15 3. The gas generator according to Claim 1 or 2, characterized in that the  
igniter unit (16, 18) does not project into the combustion chamber (26, 28).

4. The gas generator according to any of the preceding claims, characterized  
in that the combustion chamber (26, 28) has an axially arranged filling opening.

20 5. The gas generator according to any of the preceding claims, characterized  
in that the combustion chamber (26, 28) is constructed without an undercut.

6. The gas generator according to any of the preceding claims, characterized  
in that the combustion chamber (26, 28) is cylindrical and its longitudinal  
direction runs parallel to the central axis (A) of the outer housing (10).

25 7. The gas generator according to any of the preceding claims, characterized  
in that between the inner face of the outer housing (10) and the combustion

chamber wall (32) a distribution space (40) is provided for ignition gas produced by the igniter unit (16, 18), the ignition transfer opening (50, 58) opening into the space (40).

8. The gas generator according to Claim 7, characterized in that the  
5 distribution space (40) extends across the entire axial length of the combustion chamber (26).

9. The gas generator according to any of the preceding claims, characterized  
in that the outer housing (10) has outflow openings (44) and an expansion space  
(42) for gas is provided between the combustion chamber (26, 28) and the outflow  
10 openings (44).

10. The gas generator according to Claim 9, characterized in that the  
expansion space (42) extends across the entire axial length of the combustion  
chamber (26, 28).

11. The gas generator according to any of Claims 7 to 10, characterized in  
15 that the combustion chamber wall (32) is formed by an insert which has a radially  
inwardly directed indentation to produce the distribution space (40) or  
respectively the expansion space (42).

12. The gas generator according to Claim 11, characterized in that except for  
the distribution space or the expansion space (40 or respectively 42), the insert lies  
20 with the entire surface against the inner face of the outer housing (10).

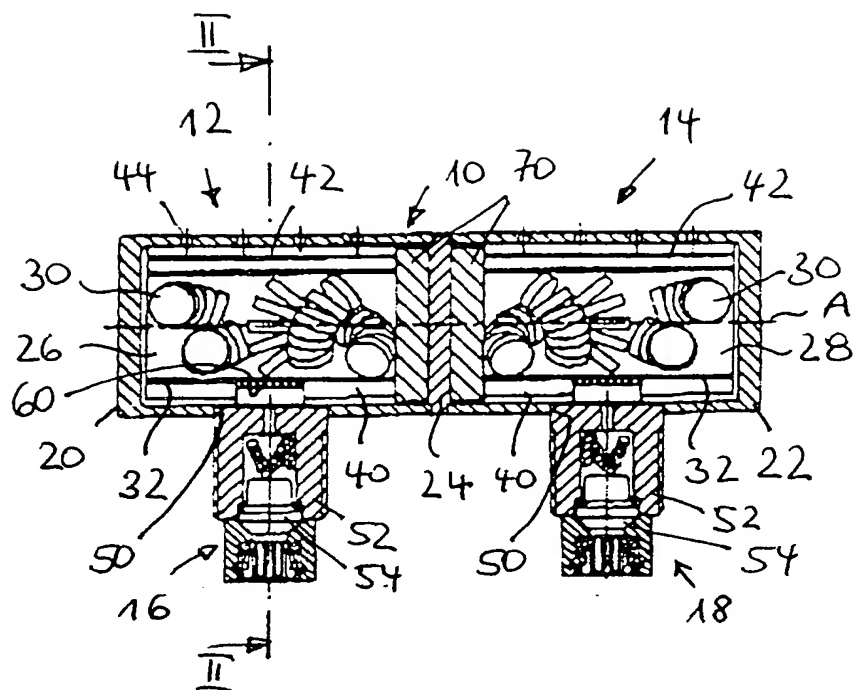
13. The gas generator according to any of the preceding claims, characterized  
in that the outer housing has outflow openings (44) which are arranged in a region  
lying diametrically opposite the ignition transfer opening (50, 58) relative to the  
central axis (A) of the outer housing (10).

Abstract

Gas Generator

A gas generator comprising an elongated, preferably tubular outer housing  
5 (10) has at least one combustion chamber (26, 28) provided therein, which is filled  
with a solid propellant (30). At least one igniter unit (16, 18) is provided for  
igniting the solid propellant (30). The igniter unit (16, 18) is arranged laterally  
externally on the outer housing (10). A radial ignition transfer opening (50, 58)  
provides for a radial introduction of the ignition gas, generated by the igniter unit  
10 (16, 18), into the interior of the outer housing (10).

Figure 1



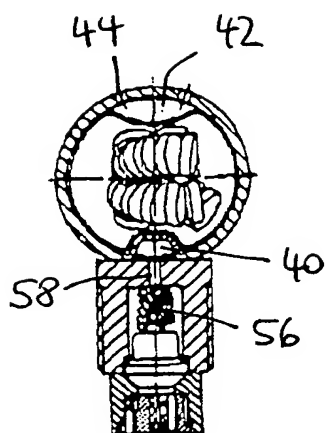


Fig. 2

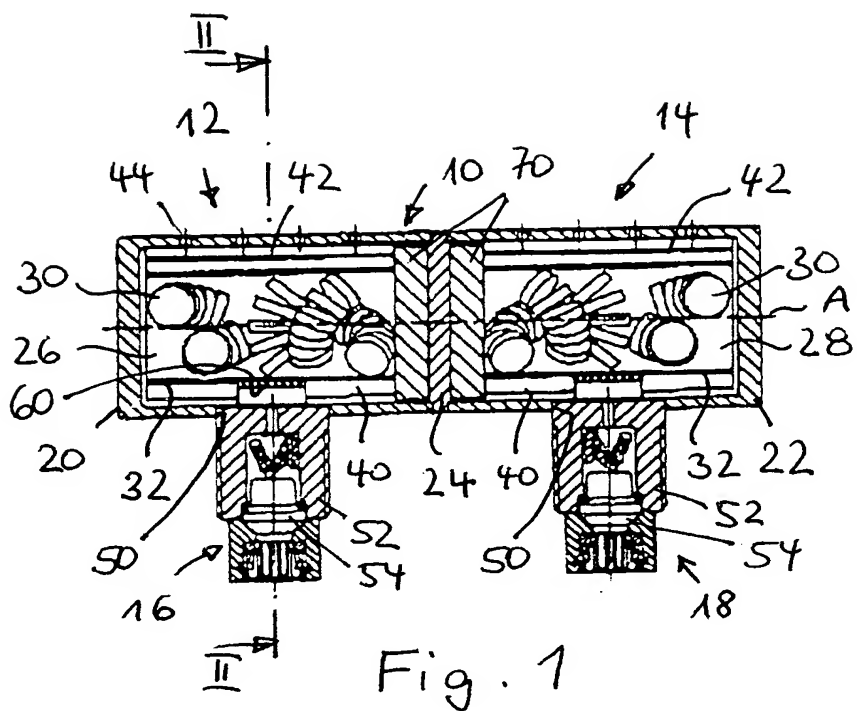


Fig. 1

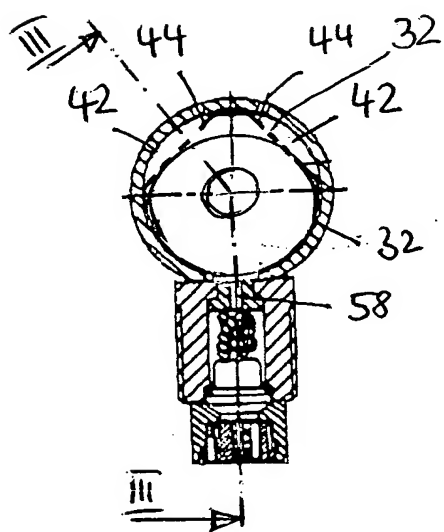


Fig. 4

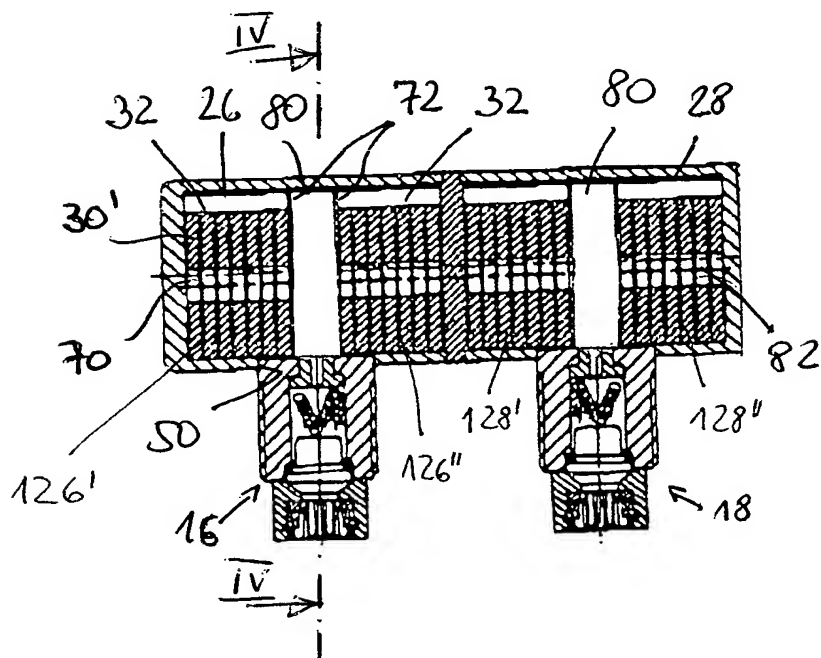


Fig. 3

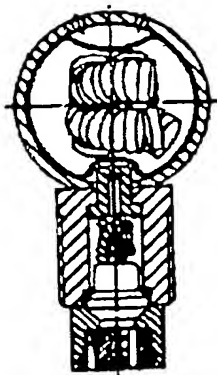


Fig. 6

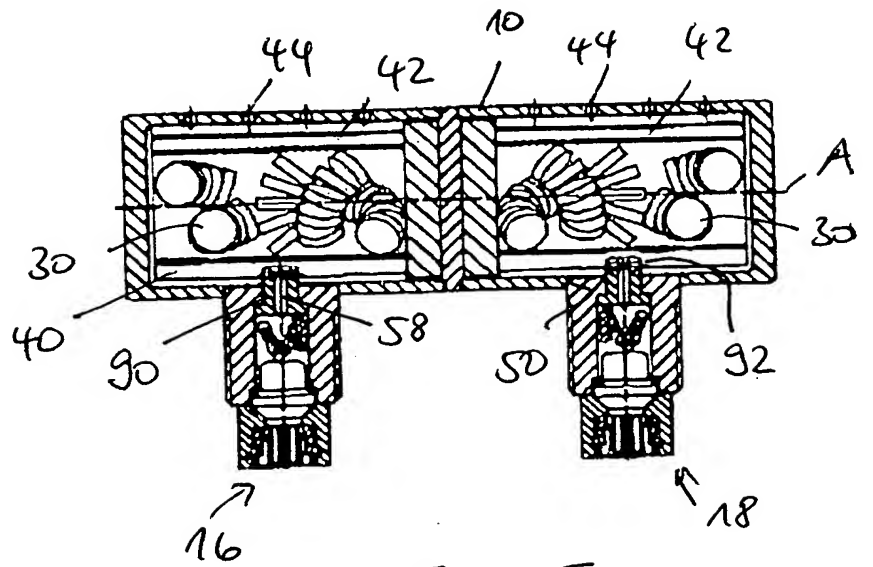


Fig. 5

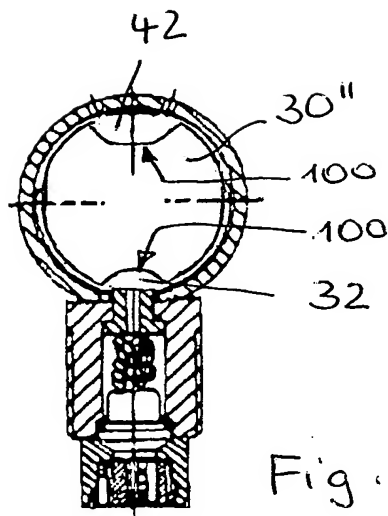


Fig. 7